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ABSTRACT

Contained within this report are summaries of activities of the New York State Science Service for the years 1977-1978. Within the introduction, the specific goals for the Science Service are listed. Activities within the following categories are summarized: services and advisory activities, education in honorarium and volunteer programs, grant or contract supported research projects, personnel changes, and museum library and publications. Research occurring within the years specified is then described. Under the Biological Survey section, descriptions appear within the following areas: botany, entomology, zoology and environmental biology. Geological Survey research is also reviewed in the areas of seismology and tectonics, regional mapping, mineral resources, geochemistry, environmental geology, and paleontology. Studies in Native American culture and salvage programs in highway projects are described in the Anthropological Survey section. Activities of the Collections Management Section are also described. Appended is a list of publications and abstracts published for the years 1977-1978. (CS)

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BIENNIAL REPORT NEW YORK STATE SCIENCE SERVICE 1977-1978

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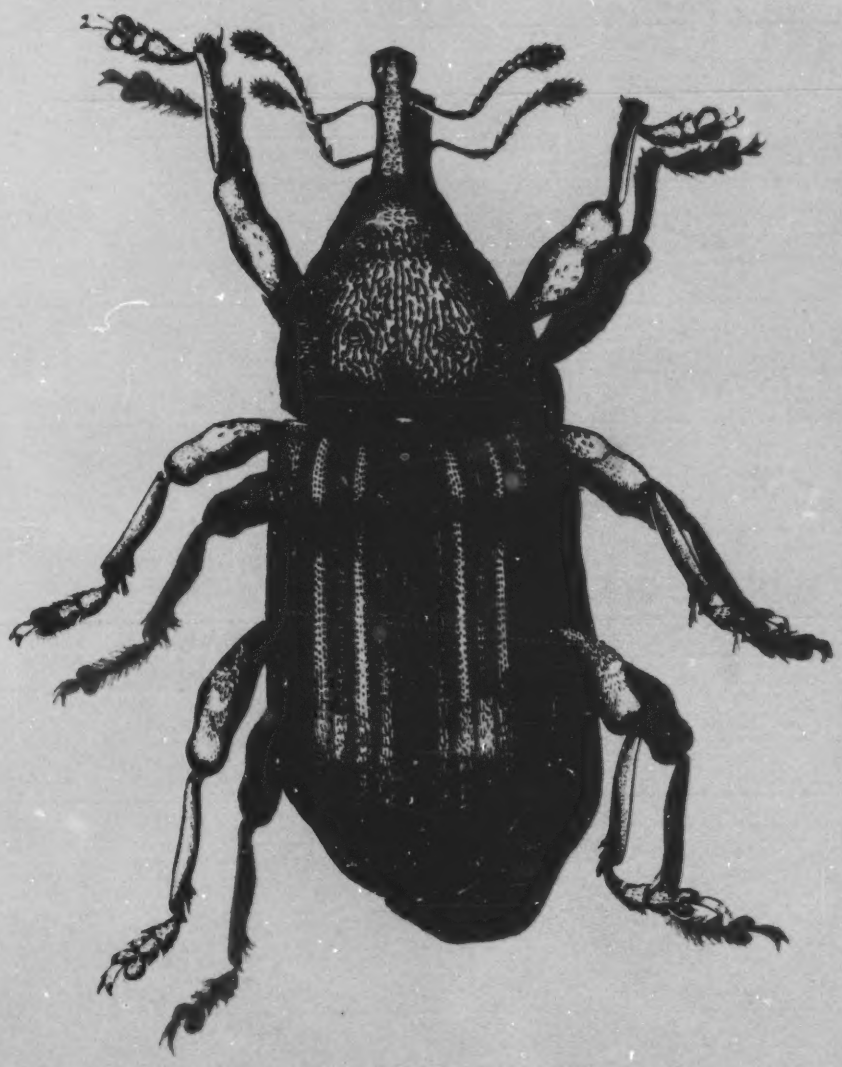

The University of the State of New York / THE STATE EDUCATION DEPARTMENT
State Science Service / Albany, New York 12230

Front cover: White Pine Weevil (see Section 2.2.1)

BIENNIAL

REPORT OF THE NEW YORK STATE

SCIENCE SERVICE*

1977-1978

*During this period the Science Service was restructured in two ways. In March 1978 a Collections Management Section was formed and in October 1978 the Anthropological Survey (excluding collections) was administratively transferred to the newly formed Division of Historical and Anthropological Services. The Science Service now consists of the following:

- The Biological Survey
- The Geological Survey
- The Collections Management Section

THE UNIVERSITY OF THE STATE OF NEW YORK

Regents of The University (with years when terms expire)

1981	Theodore M. Black, A.B., Litt.D., LL.D., Pd.D., D.C.L. L.H.D. Chancellor	Sands Point
1988	Willard A. Genrich, LL.B., L.H.D., LL.D. Vice Chancellor	Buffalo
1986	Kenneth B. Clark, A.B., M.S., Ph.D., LL.D., L.H.D., D.Sc.	Hastings on Hudson
1983	Harold E. Newcomb, B.A.	Owego
1982	Emlyn I. Griffith, A.B., J.D.	Rome
1983	Mary Alice Kendall, B.S.	Rochester
1984	Jorge L. Batista, B.A., J.D., LL.D.	Bronx
1982	Louis E. Yavner, LL.B.	New York
1986	Laura Bradley Chodos, B.A., M.A.	Vischer Ferry
1980	Martin C. Barell, B.A., I.A., LL.B.	Kings Point
1981	Joseph R. Bongiorno, B.S., M.D.	Brooklyn
1984	Louise P. Matteoni, B.A., M.A., Ph.D.	Bayside
1981	J. Edward Meyer, B.A., LL.B.	Chappaqua
1985	Arlene B. Reed-Delaney, B.A., M.D.	Albany
1987	R. Carlos Carballada, B.S.	Arcade

President of The University and Commissioner of Education
Gordon M. Ambach

Executive Deputy Commissioner of Education
Joseph J. Blaney

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1.0 INTRODUCTION

The Science Service is derived from the New York State Geological and Natural History Survey which was created in 1836. When it was established as a distinct entity within the State Museum in 1945, the charge given to the Science Service was very broad. It was *"empowered to engage in such scientific research as directed by law or by the regents and shall cooperate with scientific units or agencies of other states, the federal government, educational institutions and industry in the discovery, analysis and dissemination of scientific information."*

In view of the growing needs for natural resource information and limited resources available to provide this information, the Science Service has developed a detailed series of goals which it has submitted for consideration. The duties and responsibilities are listed as follows:

GOAL 1:

To develop and maintain an inventory of the natural resources of New York State, and to conduct research on these resources, identifying and emphasizing those which are rare, endangered, economically or environmentally important or of other significance.

GOAL 2:

To study natural processes, such as seismic activity, environmental change and ecological succession, that have occurred or are occurring in the State, to advance our knowledge and understanding of natural processes so as to develop predictive models.

GOAL 3:

To interpret, synthesize and publish the results of research on natural resources and make recommendations to citizens, industry and government regarding responsible utilization and preservation.

GOAL 4:

To act as custodians of the State's extensive and growing scientific collections so as to insure their preservation; to conduct research on these collections and make available data associated with them for natural resources studies, ecosystem analyses, and other research projects.

GOAL 5:

To maintain and make available for use comprehensive data files which describe the full scope of completed studies and current research projects dealing with New York's natural resources.

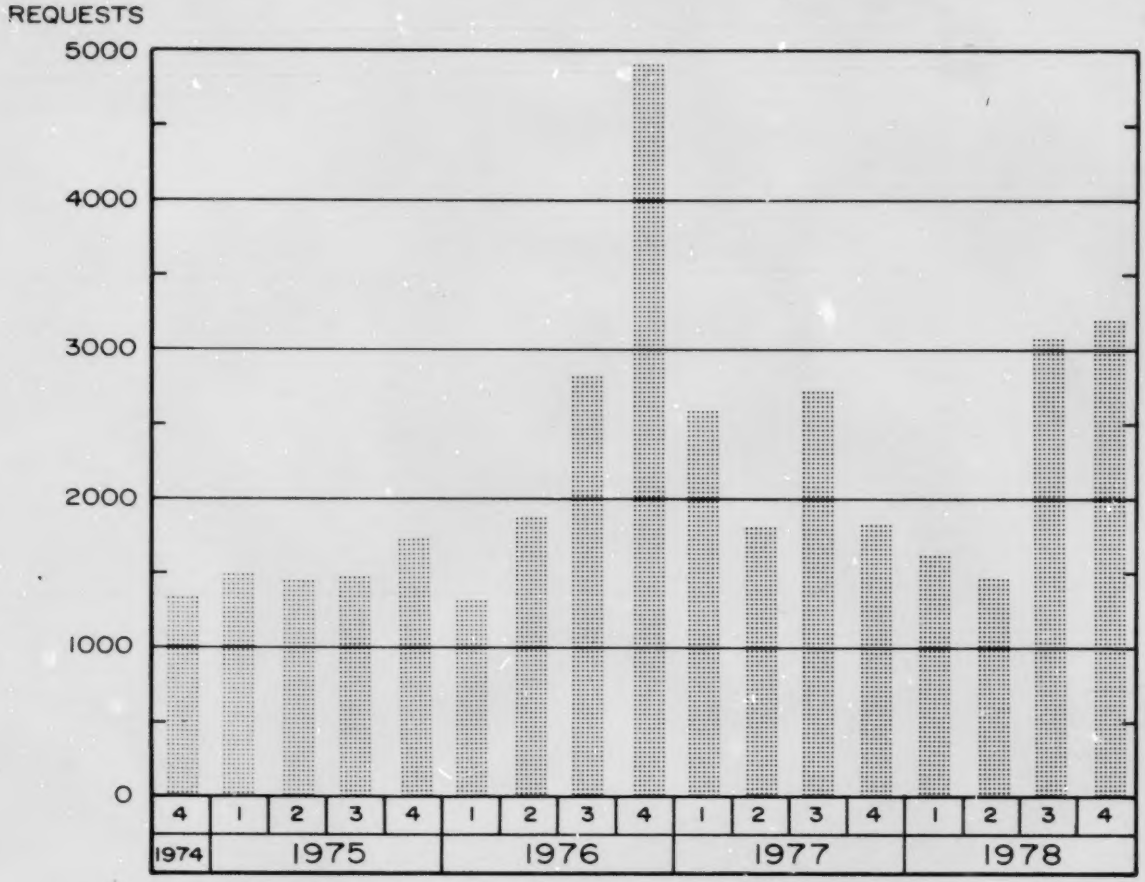
The Science Service has 30 professional positions and a support staff of 16 laboratory workers.* There are 37 temporary classified professionals and technicians working on grant or contract projects. Although the principal laboratories and offices of the Science Service are located in the Education Building, Albany, New York, they are scheduled to move to the Cultural Education Center in the spring of 1979. Oil and gas field studies are centered at a field station on the campus of Alfred University. Biological control studies are carried out at the Cambridge field station. Research on radioactive waste management is centered at West Valley, New York.

1.1 Services and Advisory Activities

There has been a leveling off of advisory activities (Fig. 1). This is due in part to staff vacancies during appreciable portion of these two years and also the failure to obtain First Instance funding establish a system of charge-back that could be used to hire scientists and technicians.

*The Anthropological Survey is included, although it was transferred from the Science Service to the new Division of Historical and Anthropological Services near the end of the report period (October 1978).

SUMMARY OF SCIENCE SERVICE ADVISORY ACTIVITIES



Hours spent on each request

1975 - 1.37
1976 - 1.11
1977 - 1.30
1978 - 1.69

Percent Request from other Agencies

1975 - 50.2%
1976 - 72.6%
1977 - 48.7%
1978 - 71.5%

Figure 1

Also deferred because of lack of funding is a plan to develop a Natural Resources Document Inventory Center. This document center will bring together all available reports of investigations, theses, maps, distribution lists, etc. pertaining to New York State. When microfilmed and catalogued, all these data will be available at a single location, the Science Service Library. These, together with standard references and a complete set of Science Service publications on the State's resources, as well as the publications available from the State Library (in the same building), will enable users to review quickly all available information for environmental analyses and reviews.

Important examples of current Science Service activities fulfilling service and advisory functions include the following:

1) West Valley Low Level Radioactive Waste Disposal Project.
   Significant findings to date in the large-scale program include:
   - The discovery of radioactive gas (tritium) leakage from the low level storage sites;
   - The first retrieval of in situ samples from beneath the burial trench; and,
   - Initiation of studies evaluating the effect of long-term changes in land form or storage site.

2) Development of lists of plant species for the U.S. Fish and Wildlife Service and the Department of Environmental Conservation.
   The State Botanist and his staff are investigating the present status of rare and endangered or threatened plant species in the State. Maps of their current distribution will be prepared after visits to sites

where they have been recorded. Thereafter, habitat profiles will be prepared to determine whether these environments should be protected by law.

3) Development of an archeological site list for research workers and impact analysts.

The Anthropological Survey has developed a site list of about 5,000 known archeological sites for the State. This will be of considerable value to research workers and individuals or groups preparing cultural impact reviews for specific proposals.

1.2 Education

1.2.1 Honorarium Program

The Honorarium Program provides grants to college seniors and graduate students to support research projects in biology, geology and anthropology of particular value and interest to New York State. Because of budgetary restrictions, this program was suspended for the years 1977 and 1978. Suspension of this program which provides small stipends to students was particularly unfortunate. Over the past years many of these students aided by the Honorarium Program were encouraged to enter various fields of the environmental sciences and some have become outstanding leaders in their areas of specialization.

1.2.2 Volunteers

The Volunteer Community Service Program is part of the State University of New York at Albany curriculum. Students at the University receive three credits for six hours work on Science Service projects per week for a semester. In 1977 and 1978 a total of 34 students volunteered to work with the Science Service staff. Volunteers included:

ARCHEOLOGY

Madeline Krakowsky
D. Peter Kvietok
Nydia Stein
Elizabeth Atkinson
Susan Fisher
David Kardesh
Lori Klein
Maureen Malloy
Brenda Foster
Elizabeth von der Heide
Marcia Lebenbaum
Nancy Hafele
Wendy Lurie
Jackie Donlon
Dennis Donlon
Donald Cornell
Gregory Laden
Karen Hartgen
Sabatino D'Ascoli
Jan Mars
Gail Mayer
Ann Chusid
Frederick Kitzrow

BIOLOGY

Kathleen McKinley
Scott Roberts
Donna Willi

GEOLOGY

Thomas Cullen
John Kaspkowicz
Kathi Ross
Jan Stahl
Marlene Michaelson
Joanne Emeric
Michael Wieznoff
Paul Ginther

1.3 Grant or Contract Supported Research Projects

The Science Service is working on 15 grants or contracts totalling $1,207,561 (some run for several years). These deal primarily with research on energy or environmental hazards.

1) Project: Devonian Black Shales Project

Purpose: To study the potential for natural gas production from black shales.

Contract Period: July 1, 1976 to September 30, 1979

Funding: $125,875

Agency: U.S. Department of Energy

Principal Investigators: Lawrence V. Rickard and Arthur VanTyne

2) Project: Erosion Study at West Valley

Purpose: To determine rates of erosion on the modification of land forms at the West Valley Low-Level Radioactive Burial Site.

Contract Period: September 1, 1977 to April 30, 1979

Funding: $147,206

Principal Investigators: Robert H. Fakundiny and Robert H. Fickies

3) Project: Southern Tier West Project

Purpose: To determine geologic structures in oil and gas fields by remote sensing techniques.

Contract Period: March 3, 1978 to December 15, 1978

Funding: $45,000

Agency: Southern Tier West Regional Planning and Development Board

Principal Investigator: Arthur M. VanTyne

4) Project: Evaluation of the Retention of Radioactive Nuclides in Fractured Soil and Rock

Purpose: To determine movement of radioactive materials from low-level waste storage sites.

Contract Period: July 1, 1975 to March 31, 1979

Funding: $468,000

Agency: U.S. Environmental Protection Agency

Principal Investigators: James F. Davis and Robert H. Fakundiny

5) Project: West Valley Disposal Workshop

Purpose: To gather as an advisory panel together to review the research at West Valley.

Contract Period: June 1, 1977 to June 30, 1978

Funding: $7,000

Agency: U.S. Environmental Protection Agency

Principal Investigator: James F. Davis

6) Project: Brittle Structures Map

Purpose: To map known and inferred faults and brittle structures.

Contract Period: July 1, 1976 to January 31, 1977

Funding: $15,600

Agency: U.S. Nuclear Regulatory Commission

Principal Investigator: Yngvar W. Isachsen

7) Project: Clarendon-Linden Recent Movements and Vibroseis Study

Purpose: To study the seismic risk of the Clarendon-Linden fault system in relation to power plant siting.

Contract Period: June 17, 1975 to April 30, 1978.

Funding: $55,000

Agency: U.S. Geological Survey

Principal Investigators: Robert H. Fakundiny and Paul W. Pomeroy

8) Project: Clarendon-Linden Fault Extension Study

Purpose: To study the Clarendon-Linden fault system beneath Lake Ontario using marine profiling techniques.

Contract Period: March 1, 1976 to August 16, 1977

Funding: $19,300

Agency: U.S. Nuclear Regulatory Commission

Principal Investigators: Paul W. Pomeroy and Robert H. Fakundiny

9) Project: Evaluation of the Impact of Natural Resource Information on Land-Use Decision Making

Purpose: To determine the effectiveness of natural resource information transfer from producer to user.

Contract Period: June 1, 1975 to January 31, 1978

Funding: $107,000

Agency: National Science Foundation

Principal Investigator: James F. Davis

10) Project: Fracture Studies in New York: BCI, BCII, BCIII

Purpose: To investigate fractures in bedrock of northern New York and their relationship to seismic risk.

Contract Period: July 1, 1976 to June 30, 1979

Funding: $65,300

Agency: U.S. Nuclear Regulatory Commission

Principal Investigator: Yngvar W. Isachsen

11) Project: Geologic Impacts on Outer Continental Shelf Oil and Gas Resource Development of New York Coastal Zone Management Areas

Purpose: To evaluate the potential for adverse environmental impact from offshore petroleum production.

Contract Period: July 1, 1976 to June 30, 1977

Funding: $25,000

Agency: U.S. Office of Coastal Zone Management through the New York State Department of State

Principal Investigator: James F. Davis

12) Project: Geochemistry of Anorthosite and Related Rocks

Purpose: To investigate the reactions involved in the formation of garnet coronas in anorthosites and olivine metagabbros.

Contract Period: March 1, 1978 to February 28, 1980.

Funding: $31,000

Agency: National Science Foundation to Colgate University

Principal Investigator: James McLelland and Philip Whitney

13) Project: Rare, Endangered and Threatened Species

Purpose: Make field studies and a list of rare, endangered and threatened plant species of New York State.

Contract Period: 1978 -1979

Funding: $10,000

Agency: U.S. Fish and Wildlife Service

Principal Investigator: Richard S. Mitchell

14) Project: Evaluation of Simulium larvicides

Purpose: To measure the effectiveness of chemical insecticides against black fly larvae.

Contract Period: 1978

Funding: $5,000

Agency: World Health Organization

Principal Investigator: Hugo Jamnback

15) Project: The Sulfur Cycle and Heterotrophic Productivity by Planktonic Microbial Communities

Purpose: To determine changes in microbial communities in lakes resulting from pollution.

Contract Period: 1978-1980

Funding: $81,280

Agency: National Science Foundation

Principal Investigator: Richard H. Monheimer

1.4 Personnel

1.4.1 Annual Staff Evaluations

The fourth Annual Staff Evaluation was held in June 1977. Lawrence V. Rickard was advanced from Associate Scientist (Geology) to Principal Scientist (Geology).

The 1978 Annual Evaluation was held in June and five scientists were recommended for advancement. These are as follows:

- Bruce M. Bell, Associate Scientist (Paleontology) to Principal Scientist (Paleontology)
- Robert Dineen, Scientist (Geology) to Senior Scientist (Geology)
- Robert Fakundiny, Associate Scientist (Environmental Geology) to Principal Scientist (Environmental Geology)
- Philip Lord, Scientist (Archeology) to Senior Scientist (Archeology)
- Arthur VanTyne, Senior Scientist (Geology) to Associate Scientist (Geology)

1.4.2 Staff Changes

James Davis resigned his position as Chief of the Geological Survey in March 1978 to become State Geologist of California. Jim had joined the New York State Geological Survey in 1961 as Scientist (Economic Geology) and was advanced, in 1966, to Senior Scientist (Environmental and Economic Geology). When State Geologist John G. Broughton was appointed Assistant Commissioner for the State Museum and Science Service in 1968, he made Davis Acting State Geologist and Principal Scientist. Since 1970, Davis

had been State Geologist and Principal Scientist. He was instrumental in broadening the scope of Survey activities by instituting studies in land-use planning, power plant siting, radioactive waste disposal, offshore petroleum resources, and seismology. Until 1973, he edited the Empire State Geogram, which he initiated in 1962. This publication on research and other activities relevant to the study of geology in New York has helped to unify the geologic community in New York. Notable publications of the State of New York Geological Survey which have appeared under Davis' leadership were the 1970 Geologic Map of New York (1972), the 1975 and 1977 revised correlation charts of New York sedimentary rocks, the 1977 surficial map of New York (Niagara Sheet), the 1977 seismic activity map, and the 1977 New York brittle structures map.

Robert Fickies joined the Science Service on April 27, 1978 as an Associate Scientist (Environmental Geology). Mr. Fickies graduated from Brooklyn College and has been employed by several engineering geology firms. Mr. Fickies is a specialist in engineering geology and has experience in mineral aggregates, geophysics and reclamation work.

Walter Mitronovas joined the Science Service as an Associate Scientist (Seismology) on February 13, 1978. He received his bachelor's degree from Pennsylvania State University in 1959, his master's from the California Institute of Technology in 1961, and has a doctorate from Columbia University, awarded in 1969. His research has dealt with underground nuclear detection problems, seismic wave propagation and instrumentation, deep seismicity in the Fiji-Tonga area and surface wave dispersion analysis. His work for the Geological Survey is directed toward better understanding the frequency, causes and dynamics of

earthquakes in New York State, the Northeast Seismic Network and analysis of seismic problems in nuclear power plant siting.

Charles Sheviak joined the Science Service on December 1, 1978 as Curator of Botany (Senior Scientist). He received his doctorate from Harvard University in 1976, and has since been the director of the Illinois endangered plant species program. His past research and dissertation were on bog orchids, which were once plentiful in New York State, but are now threatened and protected by law. He will be responsible for the State Herbarium.

Henry Bailey joined the Science Service as an Associate Scientist (Geology) on December 21, 1978. Mr. Bailey received his bachelor's degree in geology from Colgate University in 1950, and his master's degree from the University of Wisconsin in 1956. His geologic mapping experience includes petroleum exploration mapping, quarry mapping for structural interpretation and regional mapping for mineral exploration. His work for the Geological Survey will include research and advisory activity in the areas of power plant siting, nuclear waste disposal, power and gas transmission lines location, geological hazards to the public, outer continental shelf drilling, land use planning, and mineral and energy resource evaluation.

1.4.3. New Chiefs for the Biological and Geological Surveys

Effective November 23, 1978, Robert H. Fakundiny was appointed Chief of the Geological Survey and Richard H. Monheimer was appointed Chief of the Biological Survey.

Mr. Monheimer earned degrees from Syracuse University (B.S. 1962) and Michigan State University (M.S. 1965; Ph.D. 1968).

His graduate work at Michigan State University dealt with wildlife and aquatic ecology. He joined the Biological Survey staff in 1974 as an Associate Scientist (Environmental Biology). Since then he has conducted research in several areas of ecology, including studies of microbial populations in aquatic systems, the dynamics of mineral cycles in lakes, and land-use decision-making policies. This research has been supoorted by grants from the National Science Foundation. Mr. Monheimer has numerous scientific publications to his credit.

Mr. Fakundiny earned his degrees from the University of California at Riverside (B.A. 1962) and the University of Texas at Austin (M.A. 1967; Ph.D. 1970). In his New York State Geological Survey employment he has previously served as Senior Scientist (Environmental Geology) (1971-1974), Associate Scientist (Environmental Geology) (1974-1978) to Section Head (Energy and Environmental Geology) (1978). His research with the New York State Geological Survey has been primarily concerned with various aspects of environmental geology, including radioactive waste disposal, watershed mapping, land-use studies, seismic hazards associated with power plant siting, mineral resources, and applications of glacial geology studies to environmental geology. He has published more than thirty scientific reports, papers or abstracts.

1.4.4 New Head, Collections Management Section

Effective March 1, 1978 Bruce Bell was appointed Head of the newly formed Collections Management Section (see 5.0).

Mr. Bell received his degrees from Earlham College (B.A. 1963), Richmond, Indiana and from the University of Cincinnati (M.S. 1966; Ph.D. 1972). He joined the New York State Geological Survey as Associate Curator of Paleontology in 1969, and two years later he was promoted to Senior Scientist (Paleontology). In 1975, he became Associate Scientist (Paleontology), functioning as curator of the fossil collections. In this capacity he authored nine publications, principally on the Edrioasteroidea. His paper "Phylogenetic implications of ontogenetic development in the Class Edrioasteroidea (Echinodermata)" received The Society of Economic Paleontologists and Mineralogists outstanding paper award for 1976.

1.4.5 Deceased

Stanley J. Smith, Curator of Botany for the State Museum for over 30 years, died at the age of 62 on July 20, 1978. He joined the staff of the New York State Museum in 1947. While at the museum he compiled voluminous files and lists of information on the distribution of New York plants. These are, and have been, extremely valuable to botanists and agencies, and will be used in writing a New York State flora. His field knowledge of mosses was widely known, and his check-list of New York grasses has been well accepted and much used. Neither his list of publications nor printed acknowledgment from those he helped, accurately reflects his impact on botany and conservation. This is well expressed by a letter to Stanley from Ex-Commissioner Berle of the Department of Environmental Conservation which states:

"Your yeoman labors as chairman of our Advisory Committee on New York's Protected Native Flora have contributed significantly to this Department's ability to protect the State's natural environment -- and particularly its critical habitats -- both now and throughout the years to come. Your national reputation for encyclopedic field knowledge of the botanical resources of New York and your decades of work as Curator of the Herbarium at the State Museum have to a unique degree caused State agencies such as DEC and private organizations such as the Nature Conservancy and the Federated Garden Clubs to view your services as indispensable."

1.5 Museum Library and Publications

In 1976 Donald Roberts, the Museum Librarian, was transferred back to the State Library and it had been necessary to close the library for an extended period. It is now open on a three day per week basis employing a part-time librarian, Sarah Browne. Sales of Museum publications have been handled by a succession of part-time librarians including Seth Russo, Peter Feinberg, Elaine Clark and Margaret Waggoner. Sales of Museum publications average about $1,000 per month.

2.0 BIOLOGICAL SURVEY

The Biological Survey collects, identifies, classifies and preserves plants and animals of New York State and studies their relationship to man and his environment.

2.1 Botany

Scientists of the Botany Section research, compile and publish information on the plant life of the State. An increasing number of requests for these data are being received from other agencies, municipalities, taxpayers, and corporations for use in assessing environmental problems. The herbarium houses over 200,000 specimens, plus extensive distribution records. These are continually augmented and updated.

2.1.1 Flora of New York State

Established by the Office of the State Botanist in 1976, the goal of this project is to produce an authoritative and useful treatment of the plant life of the State which will enable scientists and other knowledgeable individuals to identify and determine the distribution and uses of individual plants. A steering council chaired at the Museum includes plant experts from the New York State Museum, Cornell University, Environmental Science and Forestry at Syracuse, the New York Botanical Gardens, and the State University of New York at Binghamton. Contributions, each dealing with a separate group of plants, are to be published as Museum Bulletins.

The first of these fully illustrated contributions, published in March 1978, treated the Buckwheat Family (Polygonaceae), a group that is important as a major wildlife food in wetlands as well as providing rhubarb and buckwheat for human consumption. The second Flora Contribution,

now in press, treats ten small plant families, including magnolias and waterlilies. A third manuscript, now in the editing process, is an outside contribution from a professor at the State University of New York at Binghamton. This latter contribution will treat all of New York's peatmosses, many of which are of commercial interest. With the preparation of each of these manuscripts, distribution records were gathered from all major plant collections with significant New York holdings. The data were used in making distribution maps for publication and were also added to the master-file for future use in environmental planning.

During the report period additional field studies were carried out by the Curator of Botany and the State Botanist who made extensive collections of mosses, liverworts, lichens and flowering plants. New specimens were checked against the range maps on file and new records were noted. For the vascular plants, 1,954 new county records were added (1977-1978). A new checklist of mosses is nearing completion. Since the original publication of such a list in 1957, 35 new species and many hundreds of distribution records have been added.

2.1.2 Fossil Pollen Studies

A fossil pollen study (in cooperation with the Geological Survey) of an area including four sites from the mid-Hudson Valley and glacial Lake Albany has been in progress over the last few years. New interpretations of the nature of vegetational succession and its causes, particularly during immediate postglacial time, have been developed. The resurgence of a spruce forest 10,000 years ago, as shown in the pollen diagrams of this area, is an artifact due primarily to a period of relative dryness rather than the climatic cooling

proposed by some northeastern palynologists. The so-called "xerothermic" period of dry climate is especially striking at one of our pollen-analyzed sites. This dry period which began about 4,000 years ago is conjectural among palynologists as to its intensity and duration.

This study should embellish the glacial chronology proposed by other workers to the north and south in eastern New York State and New England by filling gaps in a "transect." Conclusions as to this chronology in our study area await the results of radiocarbon-dated bog sediments. A report on this work is approximately two-thirds completed.

A fossil pollen study of sites in the upper Susquehanna River drainage associated with Indian occupation is being conducted in collaboration with the State Archeologist. Pollen analysis in these circumstances attempts to reconstruct the past changes in vegetation to suggest their climatic and other environmental causes (i.e., thermal and moisture changes) and to relate these to Indian cultures. Recovery of pollen from archeological digs may give more direct evidence of the local vegetation and of the types of Indian food and utility plants. Recovery of sufficient pollen from the archeological digs for meaningful analysis has been, so far, unsuccessful. Samples will be reprocessed to more fully define the forest successions of the last 2,000 to 3,000 years and to integrate directly the archeological and palynological studies.

2.1.3 Modern Pollen Studies -- Pollen Rain

Pollen deposition has been monitored on the Education Building Annex rooftop over many years. Such studies have been of value in determining the long-distance transport of pollen in storm systems and

the temporal incidence of the air-spora. The method of collection on adhesive coated slides does not permit reliable quantification of pollen per unit volume of air, but advantages in optical quality of the samples and their ability to collect and retain pollen in periods of adverse weather often result in data qualitatively superior to those obtained with volumetric samplers. The potential of this long-term project has not been fully realized, but it is expected that the results will show changes in the yearly airborne pollen census and aid in determining if these are caused by local factors, such as changing land usage, or by remote factors, such as storminess. Pollen depositional data are used by Pleistocene and Holocene palynologists to determine the relationship between fossil pollen assemblages and the vegetation producing these. This is a continuing study of the "pollen rain" in which the data have yet to be analyzed in detail.

A short course in pollen identification and sampling laboratory methods was presented at McCrone Research Institute, Chicago, as part of a course in forensic microscopy.

2.1.4 Palynology Reference Collection

The palynology reference collection has not been inventoried for some time. Maintenance and additions to the collections is a continuing activity. Polliniferous material is collected in the field, dried, and stored in packets at a rate of 50 to 100 collections per year. Additional material is collected from the field or herbarium as specific needs require. Pollens are also processed for comparison with their fossil counterparts and stored in vials. Pollens mounted on microscopic slides are prepared for comparison with both fossil and modern airborne pollens.

These are supplemented by some pollen from commercial sources and from exchanges with colleagues. At the last full inventory in 1977 the microscope slide collection was represented by over 3,000 slides from 1,700 collections of 1,150 taxa of flowering plants and cryptogams.

2.1.5 Airborne Fungus Spores

A systematic air sampling program to survey, identify and record airborne fungus spores in New York State is in progress. Since spores are the source of many important crop and tree diseases and cause human and animal diseases and allergies, this study has potential importance since it pinpoints the seasonal distribution and dispersion of spores. In addition to the regular sampling station in Albany County, a station was set up in Franklin County in cooperation with the Environmental Conservation Department. Samples from this site will be analyzed to monitor the periodicity and dispersion of the scleroderris canker organism (Gremmeniella abietina). This organism is a serious economic threat to Scotch Pine being grown for Christmas trees. It is hoped that the epidemiology of this destructive disease of pines will be worked out, and that control and prevention measures can be made more effective against its spread. The data from Albany County are being used as a base to examine the influence of environmental factors on the air-spora.

Lectures and workshops on allergenic fungus spores were presented as a part of continuing education for physicians. Basic introductions to the subject were given as well as new information from recent research. A workshop on airborne spores was also conducted for aerobiology researchers.

2.1.6 Fungus Collections

Emphasis was placed on making the collection available for research. Surplus copies of "Reports of the State Botanist" (1865 to 1924), which form a catalogue of early museum collections, were organized and offered for sale or exchange (Fig. 2). Lectures, field trips, workshops, and a college course were given by the curator, emphasizing the use and value of the herbarium collection in contemporary biology. Visiting mycologists, many from foreign countries, visited the herbarium following the Second International Mycological Congress which was held at Crooked Lake, Rensselaer County. This activity has resulted in an increase of specimens loaned out from 193 in 1976 to 271 in 1977, a two-year increase of 79 percent. This trend is expected to continue in years to come.

2.1.7 Rare and Endangered Species

In 1978, the State Botanist received a $10,000 contract from the U.S. Fish and Wildlife Department, Office of Endangered Plant Species. Under this contract, a preliminary list of rare, threatened and endangered plant species for New York State has been prepared from the master file of distribution ranges. This list, already in press, will be distributed widely to botanists at other institutions for their comments and revisions. In late 1979, a more complete and revised list will be prepared and submitted to both the U.S. government and the State Department of Environmental Conservation for their consideration in protecting plants under law. The hiring of the new Curator of Botany, who was formerly the Director of the Illinois Endangered Plant Program, will facilitate this effort.

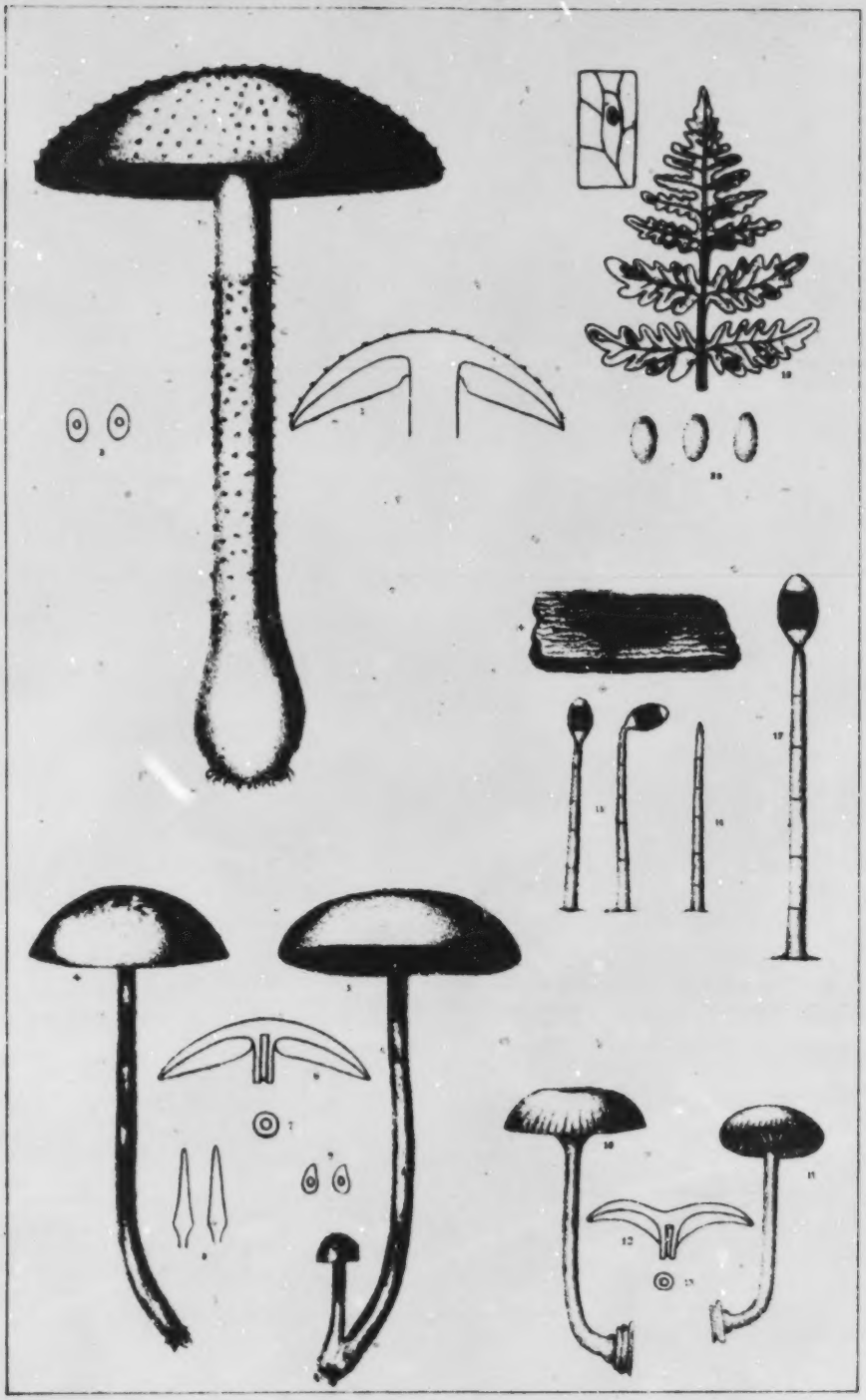


Figure 2. Illustrations of mushrooms. From, 24th Annual Report of the Regents of the State of New York on the Condition of the State Cabinet of Natural History, and the Historical Antiquarian Collections Annexed Thereto. 1870.

In the field seasons of 1977-78, many site visits were made to determine the status of rare and threatened plant populations. Notable was the Northern Monk's-hood, thought to have been reduced to a single population in the State. Three additional populations were rediscovered, one of which had not been seen for over 100 years. One of these sites contained only 13 plants.

2.2 Entomology

This section is responsible for the systematic survey and collection of the insect fauna of New York. The data are used as a reference for identification of species and for research on insect control. The State insect collection includes over 300,000 specimens. Research activities concentrate on the taxonomy and ecology of insects and mites, and on applied biological control of noxious insects and mites that affect plants and the well-being of man and animals.

2.2.1 Forest Insects - White Pine Weevil Resistance Study

Weevils breed in the tips (or leaders) of developing White Pines, causing them to die, which results in deformed trunks. Such damage greatly reduces the value of the trees for lumber. In 1969, the U.S. Forest Service stated that resistance to White Pine weevil attack would be worth about $14 million annually to the forest economy of the Northeast. The estimate is now closer to $30 million. A report on the study of resistance in Eastern White Pine begun in 1954 was completed in 1978. Results of this study using trees of known seed sources both weeviled and nonweeviled, showed that resistance to weevil attack is not

likely to be found in any particular seed source but in individual trees. A search for trees which do not become weeviled in areas where most trees are heavily weeviled is a better source of weevil-resistant trees. Cuttings taken from such "resistant" trees have been vegetatively propogated in a cooperative program with the New York State Department of Environmental Conservation. The propagules are being planted in a clonal orchard for testing and to serve as a source of genes for further genetic studies involving crosses with both Eastern and non-Eastern White Pines which exhibit resistance in the study plots. Among non-Eastern White Pine, the Western White Pine and Balkan White Pine appear resistant. Although both will develop and mature in New York State, they grow too slowly for commercial use here.

2.2.2 Aquatic Insects

The Adirondack and Catskill Mountains were intensively collected for aquatic insects during 1977 and 1978, respectively. The majority of the aquatic insects are nocturnal as adults and are attracted to the "blue-end" of the light spectrum, so they are collected in light traps using ultra-violet light. Most of the samples for this faunistic study were collected by this method. Many of these insects are important indicators of aquatic pollution.

All materials gathered by the means described above have been labeled with complete data as to date and latitude-longitude of collection. Over 100 new State records and literally thousands of new county records are represented. One new species of caddis-fly was discovered.

2.2.3 Mosquito Taxonomy and Ecology of Mosquito-Borne Disease

A treehole breeding mosquito, Aedes triseriatus, a known vector of California encephalitis virus is quite common in New York State, both in wooded areas where it breeds in treeholes containing water and in populated areas where it breeds in artificial containers. It has been found that Aedes triseriatus has two strains which differ biologically. Studies conducted in 1978 indicate that there are almost twice as many generations in one strain per year as in the other. One strain also feeds much more avidly on man than the other. Further studies are planned to determine whether or not the differences in biological life histories are significant in the transmission of arboviruses.

Manuscripts on the taxonomy of the mosquitoes of New York will be published as two State Museum Bulletins. They will bring together taxonomic and biological information on all species known to occur in the Northeast. The manuscript for Part I, entitled "Mosquitoes of New York. Part I, Genus Aedes, with keys to the genera of Culicidae occurring in New York" is currently being printed and should be available for distribution in 1979. It contains keys to the species of Aedes and a detailed discussion of each species. The manuscript for Part II is scheduled to be completed in 1980. It will deal with the species of remaining genera and will also contain information on control methods.

2.2.4 Revision of the Polia complex

The manuscript revising the moths in the Polia complex (Lepidoptera: Noctuidae), has been submitted for publication as a State Museum Bulletin. This work provides keys to the genera and species of this complex and establishes relationships between the Eurasian and Nearctic

species for the first time. Several species of Polia (cutworms) are important agricultural pests (e.g. Zebra Catepillar, Striped Garden Caterpillar, Bertha Armyworm). Now that these North American species are recognized as being closely related to European species, it should be possible for economic entomologists to use some of the same economically feasible control methods for them that are currently applied for the European species.

2.2.5 Mites of New York

This project is a continuing survey of the mite fauna of New York with emphasis on the economic species. Mites, small arthropods related to ticks and spiders, are even more abundant and diverse than insects. They cause dermatitis and certain skin rashes in humans, and are the most common cause of severe respiratory allergies in this country. Others are major pests of food plants and stored food products. The present project will provide essential species cataloguing, descriptions, and drawings that graphically show the mite morphology, and will establish a reference collection of identified mites in the New York State Museum. Because the fauna involves several groups or families of mites, each group or family when completed is reported and published in the Journal of the New York Entomology Society. Parts I through VII have been published, Parts VIII through IX are near completion. Presently, 251 species of mites are known from New York State; 67 of these were named and described for the first time in these reports. Approximately 1,700 specimens of mites mounted on slides have been processed from stored grains, house dust and insect hosts.

Acarologists of the Systematic Entomology Laboratory, U.S. Department of Agriculture, Maryland, Hamburg Museum, West Germany, and Cornell University are cooperating in this project.

2.2.6 Control of Blackflies and Mosquitoes

Blackflies and mosquitoes are pests of man and animals and transmit disease. In some areas of the State, especially resort areas, they are economically important nuisance pests. A variety of chemical and biological methods for the control of blackflies and mosquitoes are currently under study. This research is being conducted at the Biological Field Station in Cambridge.

Insect parasites (fungi, bacteria and worms) were obtained from cooperators and assayed in the laboratory against blackfly larvae. A nematode, Neoaplectana sp./Strain DD-136, which naturally infects codling moths, proved pathogenic enough to warrant further testing. Laboratory tests consistently achieved high rates of mortality and further trials are now underway to determine the conditions that are most conducive to the achievement of high mortality rates. Initial tests with a strain of Bacillus thuringiensis have shown it to be very effective against blackfly larvae and a major effort is planned for further evaluation in 1979. Other projects related to blackfly control included a descriptive and bionomic study of a new species of mermithid nematode parasitic in blackflies, and a field trial attempting introduction of mermithid nematodes into an Adirondack stream.

The toxicity of a number of new chemicals has been tested against blackfly larvae under a grant from the World Health Organization. Among these, emphasis was placed on the evaluation of insect growth regulators (IGR's). These are chemicals that kill the blackfly by interfering with normal growth and maturation. The effects of these and conventional insecticides on nontarget stream organisms must be carefully monitored.

These blackfly larvicide studies are being conducted in conjunction with C.S. Rodrigues of the University of Guelph, Ontario, Canada.

The bacterium Bacillus sphaericus is being examined in laboratory and field trials against a number of mosquito species, in collaboration with Dr. S. Singer of Western Illinois University and the Stauffer Chemical Company. This organism was successfully cultured and found to have a moderately to high activity against laboratory reared and/or field collected mosquitoes.

Liquid broth cultures of B. sphaericus were found to lose their toxicity quite rapidly under refrigeration, and this created many problems in testing procedure and data evaluation. This problem was alleviated when the Stauffer Chemical Company developed a dry experimental preparation of B. sphaericus. This material is stable with an indefinite shelf life and is also more active against Culex species than the broth cultures. A preliminary field trial in which the unformulated powder was applied to the perimeter of a C. pipiens breeding site indicated that the Stauffer material has considerable potential for control of Culex mosquitoes. Results against Aedes species have been mixed, however. Ae. vexans has been found to be highly susceptible,and Ae. triseriatus highly resistant to the Stauffer material in laboratory tests.

2.2.7 Entomology Curatorial

The transition of the entire insect collection from cork bottoms to modern, entomo-foam trays, begun in March of 1977, has been completed for the Diptera, Odonata, Polyhagen, Coleoptera, Heteroptera and Hymenoptera. This is being done for two purposes: 1) to update the cataloquing system, and 2) to protect the specimens for the move to the new Cultural Education Center.

Over 50,000 new specimens were collected in 1977-78 and have been, or are being, labeled and incorporated into the collection. Once labeling is complete, specimens become available for loans. Sixteen loans to as many institutions were made during the past year.

Type-materials have been assembled in one cabinet for the first time and a catalogue of all type specimens has been compiled and is being reviewed by the New York Entomological Society for publication. The catalogue will provide the necessary information for eventual computerization of the type-material.

2.3 Zoology and Environmental Biology

Scientists in this section are responsible for conducting research, surveying, collecting and publishing information about the animal fauna (excluding insects) of New York State. Data pertaining to birds, mammals, snakes, amphibians, fishes and invertebrate animals are frequently provided to other scientists, taxpayers, law enforcement agencies and corporations. The zoology collections comprise over 200,000 items including mounted specimens, skins, bones, nests, and eggs. Research activities have concentrated on areas of aquatic ecology, biogeography and the natural history and ecology of mammals.

2.3.1 Mammals of New York State

Work continued on the mammals of New York State, a project to produce a comprehensive State mammal book combining a technical with a semi-popular approach. The manuscript is scheduled to be published in 1981. No book dealing with this subject has been produced in this century. The main core of the text will include detailed accounts of 98 terrestrial and marine species, including identification, description,

measurement, cranial characters, distribution, status, habitats, habits, economic importance and conservation, subspecies found in New York, and specimens examined. Also a description of the State and its adjacent waters, a literature list, and a list of fossil species will be included. Illustrations will include color plates, black and white drawings, photographs, skull diagrams and distribution maps. Considerable progress has been made in preparing the illustrations and maps, much of it done in 1977. Twelve color plates, showing 67 species were completed. Twenty-three drawings of marine mammals and skull diagrams of 68 species are largely finished. Maps completed include an outline range map for each species in New York with a North American inset, an elevation map, a map showing physiographic provinces, and two locality reference maps (one of the State in relation to neighboring areas, and a State map naming counties, cities, etc.). Assembling of background information is of primary importance to this project, and in 1978 emphasis was on marine mammals. Materials were gathered from various sources including the Smithsonian marine mammal programs and East Coast alert networks. Firsthand field observations of whales and dolphins were made via five pelagic trips in 1978 with visits to the edge of the Continental Shelf and including Hudson Canyon and other marine canyons. Manuscript preparation was concerned especially with the distribution and status of various shrews, bats, marine mammals, and extirpated species (i.e., since early Colonial times).

The small mammal survey project, a statewide field study of small nongame mammals, has previously produced museum bulletins on Otsego and Schoharie counties, Tug Hill, and Long Island. Field work in this period was limited but included a study of mammals in the Albany Pine Bush (1978), evening observations of bats in several habitats, trips to Adirondack bat caves,

and snow tracking in winter. Collections of insectivores and rodents were received through cooperative work in 1977, two from Dutchess County, one from the Adirondacks, and one from the Salmon River estuary in Oswego County.

2.3.2 Population Dynamics

The immediate goal of this project is to develop techniques for understanding the metabolism of microbial communities in lakes. The long term goal is to utilize these techniques to understand the dynamics of aqatic microbial communities and their role in the functioning of lakes as entire ecosystems. Since microbial populations are sensitive to environmental changes, the techniques and information developed in this study may lead to increased sensitivity in pollution monitoring.

Radioisotope tracers are used to follow the utilization and movement of nutrients in the aquatic food cycle. Research has concentrated on Lake George in Warren County, a nutrient-poor lake that may be becoming polluted, and Canadarago Lake in Otsego County, a nutrient-rich lake which is probably "cleaning up" due to construction of a sewage treatment plant. Throughout the year, water samples are collected from various depths in the lakes and treated with the tracer materials. By measuring the accumulation of radioactivity in the microorganisms in the water samples, the activity (photosynthesis, growth rates, etc.) of them can be determined. This study has been directed at obtaining an understanding of daily and seasonal trends in the activities of the microbial communities from a theoretical point of view, but information is being obtained that will provide an understanding of the basic limnological qualities of these lakes. A National Science Foundation grant for $50,000 supported this work through the middle

of 1978, while a second National Science Foundation grant for $81,000 has been obtained for support from mid-1978 through 1980.

2.3.3 Environmental Biology

In a cooperative effort with the Geological Survey and several State and Federal agencies under U.S. Environmental Protection Agency sponsorship, the West Valley project involves the study of the potential impact on the biological component of the terrestrial ecosystem by the migration of radionuclides from the low level nuclear waste burial system. The qualitative nature of this ecosystem has been determined and the various trophic (food chain) relationships have been identified. These continuing studies will eventually become part of a comprehensive computer modeling system which may be able to answer important questions concerning nuclear wastes and nuclear waste disposal problems.

The LURIE project, sponsored by the National Science Foundation, was designed to examine the communications between the producers of natural resource information and the public officials who utilize such information in making decisions concerning land use policies. This study, which was concluded in 1978, may eventually serve to increase the efficiency in this transfer of information (3.6.4).

2.3.4 Zoology Curatorial

In preparing to move the collections to new ranges in the Cultural Education Center, identification and verification of mainly invertebrates and herptiles has been completed. During 1977, 1,142 specimens were catalogued and added to the collections.

The catalogue of the bird specimens in the New York State Museum is being computerized. This catalogue will include descriptions representing

897 species and 11,688 specimens including mounts, skins, skeletal parts, egg sets and nests.

The curator began a survey of summer birds in New York State, in cooperation with the 44 member clubs in the Federation of New York State Bird Clubs. A report is being compiled, these records being kept in the museum and maps maintained of each species to study range changes and fluctuations. This survey is to be done annually.

Birds killed flying into the buildings of the Mall added to the collections and data amounted to 104 specimens.

A bibliography has been compiled for work on a biogeography of New York State with new additions made as work progresses.

3.0 GEOLOGICAL SURVEY

The Geological Survey's programs include the monitoring and analysis of earthquake activity and modern tectonics in New York State, regional subsurface, and detailed geologic mapping, mineral resource investigation, geochemical studies, research into the nature of ancient plant and animal life (the study of paleontology), geologic mapping of nuclear waste disposal sites, and research into the dissemination of scientific data to public decision makers.

Public service activities include answering requests for oil and gas resource information, reviewing safety analysis and safety evaluation reports of proposed nuclear power plant sites, advising on the disposal of nuclear and toxic wastes in New York, providing land-use information to concerned parties, and answering routine taxpayer requests on geologic matters.

3.1 Seismology and Tectonics

The seismology program is continuing in an attempt to better understand the causes of earthquakes. This understanding is important in specifying design criteria for nuclear power plants, dams and other critical structures. Research activities include evaluating seismograph records of microearthquakes, deploying seismographs to monitor their aftershocks and testing for possible associations between earthquake activity and known faults. Structural geologic information is correlated with new information of earthquake occurrences as part of the investigation of earthquake conditions in New York State. Study continues on problems associated with the review of safety analysis and safety evaluation reports on nuclear power plants in the State. The Geological Survey disseminates earthquake hazard information to appropriate regulatory agencies at the State and Federal level.

3.1.1 Seismicity Studies

New research initiated in 1978 will attempt to characterize those properties of the earth's crust in New York that cause earthquakes to be felt differently in different directions from the epicenter. Other studies in eastern New York will attempt to define microseismicity around major warm springs to evaluate their neotectonic setting as part of an assessment of geothermal energy. Our portable seismographs have been used in cooperative projects with the State University of New York at Stony Brook and with Lamont-Doherty Geological Observatory.

3.1.2 Contemporary Vertical Crustal Movement

During 1975 it was discovered by the Geological Survey that a relatively rapid rate of vertical uplift (2.5 mm/year) was occurring in the Adirondacks. Studies are now underway to determine how long this doming has been going on. The unconsolidated sediments in Lake George, an old down-faulted basin, were studied to detect any evidence of displacement along old faults which might have occurred subsequent to deposition some 10,000 years ago. From 100 km of seismic reflection and magnetic profiling along the bottom of Lake George and vicinity, carried out in cooperation with the U.S. Geological Survey, four kinds of maps were made: bathymetric, magnetic, isopachous, and depth-to-bedrock. The results suggest faulting during the past 10,000 years, presumably connected with domical uplift of the region. Any recent reactivation of old faults is important in the evaluation by private industry of possible power plant sites and other major engineering projects.

As part of a long-range study of brittle deformation and possible Holocene faulting in New York several new studies have been initiated to catalogue and assess brittle structural features that may be related to

neotectonic movements and seismicity. Among these are: 1) a study of surface features in Quaternary alluvium along projections of faults, funded by a grant from the U.S. Nuclear Regulatory Commission; 2) preparation of a strip map along the Hudson River of localities where anomalously straight topographic features exist that suggest structural control and the possibility of unmapped faults or fracture zones, funded by a grant from the U.S. Nuclear Regulatory Commission; and 3) fault investigations in the Adirondack Mountains to determine the relationship of earthquakes to mapped faults and lineaments, funded by a grant from the U.S. Nuclear Regulatory Commission.

3.1.3 Panther Mountain

Geological and geophysical investigations of an anomalous circular valley in the Catskill Mountains west of Phoenicia are completed. Indications are that it is probably a shallow buried meteorite crater, 10 km in diameter, which struck the area during deposition of deltaic sediments about 250 million years ago. The inferred lens of brecciated rock beneath the crater may be as much as 4 km in vertical dimension. It cuts several thick black shale sequences that are source rocks for natural gas. This, and the potential of the breccia lens itself providing a large reservoir, leads to the possibility that the area is underlain by a significant gas field worthy of exploratory drilling. The U.S. Energy Research and Development Administration has supported this research.

3.1.4 Relation of Structural Geology to Seismicity

A correlation is developing between a known fault in western New York, the Clarendon-Linden Fault, and earthquake activity in that region. The fault extends in a north-northeast direction for a distance of at least 15 to 20 miles north and south of Attica. Field investigations of the fault,

begun in 1975, have been extended. This has been done to take advantage of the data analysis derived from a VIBROSEIS high-resolution seismic profile on four study lines that crossed the fault on land to determine its subsurface configurations and areal extent. These studies could be of great significance to nuclear power plant designs along the Lake Ontario shoreline. Bedrock reconnaissance mapping has been completed and has shown that there are no unequivocable surface structural features that can be associated directly with the formation of the subsurface fault.

3.2 Regional Mapping

3.2.1 Surficial Geology

Surficial geology is the geology of unconsolidated materials overlying bedrock.

3.2.1.1 Pine Bush Dunes

The sediment characteristics of the Pine Bush Dunes are being examined in a project designed to determine: 1) the direction of the winds that deposited the sand by measuring internal laminations in the dunes; 2) the processes of wind transport and deposition by study of the grain-size and grain-shape distributions throughout the dune field; 3) the mineral composition and its variation within the sand deposits; and 4) the effects of weathering by comparison of the mineralogy of near surface vs. subsurface sand sample.

Preliminary analyses of the measurements of the internal laminations indicates that the dunes were built by winds from two dominant directions, the northwest and southwest. These are the first data to support the commonly

held conclusion based on dune morphology that the paleowind was from the northwest. These data refute the recently published conclusion that the dominant dune building winds were southeasterly. As a result of this information, a different climatic picture has been established for the period immediately following deglaciation of this area.

3.2.1.2 Buried bedrock surfaces of the Hudson Valley

A study of the buried bedrock topography of the Hudson-Champlain Valleys from Newburgh to Crown Point is nearly completed, and the pre-glacial valleys have been mapped for eastern New York. These valleys were carved by rivers before the last glacial age, some 125,000 years ago. They contain deposits left by the retreating glaciers 15,000 to 20,000 years ago. The surficial and subsurface extent of these glacial deposits have been mapped in detail from Round Lake to Catskill. Glacial stratigraphy, geologic hazards, potential ground water supplies and potential sand and gravel resources are being described. The U.S. Geological Survey has cooperated in the surficial mapping.

3.2.1.3 Quaternary Map of New York

An extensive study of the glacial geology of the Hudson River Valley has been a major project within the New York State Geological Survey for several years. At the present, mapping is continuing in the Albany-Coxsackie region. This project will be collated and incorporated with others into the statewide Quaternary Map presently be compiled. The Niagara Sheet has been published at a scale of 1:250,000. The Finger Lakes Sheet is well underway and will be published within the next couple of years.

3.2.2 Bedrock Mapping

3.2.2.1 Mid-Hudson Valley

In the Kingston-Beacon area nine 7 1/2-minute quadrangles and portions of four others have been mapped. The distribution of bedrock units is shown by thirty-two different colors. The text and map will appear in the New York State Museum Map and Chart Series. These unpublished maps have been used frequently by consultants seeking information on proposed power plant sites.

3.2.2.2 Mohawk Valley

Bedrock geology in the Little Falls-Schenectady region has been rechecked. Mapping, done intermittently from 1948-1960 and from 1969-1971, is essentially complete and includes twelve 7 1/2-minute quadrangles and portions of four others.

3.2.2.3 East Central Adirondacks

Mapping was continued in the southern portion of the Jay Mountain and Lewis 7 1/2-minute quadrangles. A geologic map of the Jay Mountain Quadrangle will be prepared for publication. This study, an aid to better understanding the history of the earth's crust in the Adirondacks, stresses the structural and metamorphic history of the Adirondack anorthosite and its contact relationship with surrounding rocks.

3.2.2.4 Niagara Frontier

The Geological Survey has participated in a project designed to produce an atlas of the geology of the Niagara Frontier area. The atlas

will provide a synthesis of geological information from the State Geological Survey and other sources that will be useful to colleges and high schools in the area.

3.2.3 Subsurface Mapping

This long-term research project has provided invaluable data to the oil and gas industry and now to the search for other resources. It is the study or rock cores, chips, and geophysical logs taken from oil and gas wells.

3.2.3.1 Stratigraphy of subsurface Lower and Middle Devonian rocks

Work continued on this long-term study concerned with the composition, thickness and stratigraphic relationships of the subsurface Lower and Middle Devonian rocks of New York State and adjacent areas. This study is based on lithologic and geophysical data from over 750 wells and bore holes. The final report will contain thickness maps, lithofacies and structure maps, paleo-geologic maps, correlation tables and a descriptive text. The result of this study will be particularly important for natural gas exploration in the State.

3.3 Mineral Resources

3.3.1 Chemical Composition of Carbonate Rock

Limestone and dolostone are the highest value mineral commodities produced in New York. High-calcium limestones are potentially useful in cement manufacture. The chemical properties of limestone and dolostone aggregate influence the durability of concrete. Six years ago a study

began of the variations in chemistry of the important carbonate units throughout the State. The State Department of Transportation has supported the project by contributing core specimens from quarries within the State. Chemical analyses provided by the U.S. Bureau of Mines and the State College of Ceramics at Alfred, in collaboration with the State Geological Survey, are being statistically analyzed. New uses for carbonate rocks are still being developed. Millions of tons may be required for scrubbing of the flue gases produced by the burning of coal in power plants.

3.3.2 Oil and Gas

The Geological Survey is completing a synthesis of deep gas well records which have accumulated since 1970 when the last summary (Deep Wells in New York State, Museum Bulletin 418A) was published. The new summary, Museum Bulletin 418B, will be derived from a computer printout of well descriptions which have been put into the automatic data processing file between 1970 and 1975. It should be available for distribution in 1979.

A new study has begun to analyze and inventory the oil and gas resources of Allegany and Cattaraugus counties. Funded by the Appalachian Regional Commission through the Southern Tier West Regional Planning and Development Board, this study will define regional structure and will provide isopachus maps of potentially productive horizons.

3.3.3 Black Shales

In October of 1976, a three year investigation of Devonian black shales in New York was begun, supported by the U.S. Energy Research and Development Administration (now the U.S. Department of Energy). This work is part of a basinwide evaluation of the potential gas resources in the black shales of the Appalachian region. The intent of the study is to

evaluate the potential for development of new natural gas resources associated with black shales in western and central New York. Stratigraphic cross-sections that correlate the black shales are being prepared. These interpretations are the result of a study of geophysical and lithological logs of deep bore-holes. A detailed, long-term study of the subsurface stratigraphy of the entire Devonian system in New York and adjacent states has been in progress several years. The U.S. Energy Research and Development Administration funding will accelerate the completion of that portion of these studies dealing with the stratigraphically important black shales.

3.3.4 Outer Continental Shelf Oil and Gas

In 1971 the Federal government began a leasing program for the Atlantic Outer Continental Shelf. Since that time the coastal states have had an advisory role in the development of lease stipulations, selection of areas to be offered for leasing and the establishment of environmental safeguards. That advisory role was supported by means of a contract from Coastal Zone Management funds. The Geological Survey provides commentary for the State on geology related subjects for the North and Mid-Atlantic areas through the Outer Continental Shelf Manager for New York, in the Department of Environmental Conservation. Principle involvement in 1978 was in lease sale 49 in the mid-Atlantic area, where suggestions for deletion at a number of potentially hazardous tracts were presented. These were reviewed by the U.S. Geological Survey who agreed with our concern and established a series of stipulations that will alleviate the problems we have identified on these tracts.

A report entitled "Assessment of the Geologic Information of New York State's Coastal Zone and Continental Shelf and Its Significance to

Petroleum Exploration and Development" was produced in a typescript format. This report was designed to assess the adequacy of existing information in determining the many potential environmental consequences of the Federal leasing program. This information will be useful to local, State, and Federal agencies concerned with the Atlantic coastal areas. Editorial comments have been requested from a number of agencies before publishing.

3.4 Geochemistry

3.4.1 Heavy Metal Distribution in Streams

The behavior of heavy metals in the natural environment is important to health, agriculture, and wildlife conservation. Manganese and iron oxides minerals in streams and in the soil are some of the principle controls on the mobility of heavy metals. Currently two projects are dealing with the interaction of the oxide minerals and environmentally important heavy metals.

A study of heavy metals in stream sediments and manganese-iron oxide coatings on stream gravels in the Genesee Valley has been completed. This work set out to identify the effects of land use on the amounts of heavy metals entering streams and rivers, and was supported over a three year period by the New York State Department of Environmental Conservation. Indications are that a significant amount of lead, zinc, and copper are found in streams draining residential, commercial or industrial areas. The heavy metals are generally more abundant in streams that drain forested areas in agricultural areas. This may be either a natural consequence of the greater acidity of forest soils or related to differences in bedrock geology. Very high zinc levels in some streams in the northern portion of the Genesee Valley can be traced to small amounts of sphalerite, zinc

sulfide, in the Lockport Dolomite and to concentrations of zinc in bogs found on the Lockport.

Samples of manganese oxide-coated gravels were obtained from streams in northern Saratoga County in an attempt to evaluate the areas that have potential for economic zinc deposits. Large, anomolous values were found in the area of Fox Hill and Lake Desolation which could not be traced to a bedrock source. The high values are apparently a result of an unusually acid environment that increases the mobility of zinc as a result of a combination of acid precipitation and the local geology.

3.4.2 Adirondack Geology and Geochemistry

The overall purpose of this study is to better understand the geologic history of the Adirondack area, through the use of modern geochemical methods. Studies of "fossil" chemical reactions in various Adirondack rocks by means of electron microprobe analyses are yielding information on the conditions under which these rocks were formed. The rocks in the central Adirondacks apparently crystalized at temperatures in excess of 800°C (1470°F) and at depths in the earth's crust of up to 25 km (15 miles).

3.5 Geophysical Studies

3.5.1 Aeromagnetic Map of New York

Producing an aeromagnetic map of New York State has been the goal of a long-term cooperative program with the U.S. Geological Survey. Aeromagnetic maps show the magnetic signatures of rocks that lie deep within the earth and provide a method for extending knowledge of geologic structures of basement rocks from exposures, such as the Adirondack dome of Precambrian rocks, to regions where basement rock is covered by Paleozoic sedimentary

strata and glacial material. Central New York was the last area lacking such data. This has now been done, and a preliminary aeromagnetic map will be available late in 1979.

3.6 Environmental Geology

3.6.1 Nuclear Power Plant Siting

The Geological Survey regularly reviews geologic and seismologic information and conclusions proposed in Safety Analysis Reports by applicant utilities for siting individual nuclear plants. Also, advice is given to power utility companies, their consultants, and to the New York State Public Service Commission, the Department of Environmental Conservation, the Department of Commerce, and the New York State Atomic Energy Council. The Geological Survey provides these services as the only inhouse source of geological data existing in the State that is independent of private consulting or regulatory activities. Projects recently reviewed include:

1) Nuclear plant site at Sterling - Rochester Gas and Electric
2) Nuclear plant site at Jamesport or Shoreham - Long Island Lighting Co.
3) Nuclear plant site in Greene County - Power Authority of the State of New York
4) Nuclear plant site in Columbia County - New York State Electric and Gas Co.
5) Nuclear plant site in Oswego County - New York State Electric and Gas Co.
6) Fossil fueled plant site at Dunkirk on Lake Erie
7) Fossil fueled plant in Tompkins County - Rochester Gas and Electric
8) Nuclear plant at Ninemile Point - Units No. 2 and 3.

3.6.2 Study of Radionuclide Retention at the Shallow Burial Facility at West Valley, New York

The Geological Survey was designated the lead State agency in 1975 to participate in a study of the potential pathways by which radionuclides migrate from the shallow low level waste burial trenches to the environment at West Valley, New York. Funding of this project, which has been received from the U.S. Environmental Protection Agency and the U.S. Nuclear Regulatory Commission totaled $615,00 at the end of 1978. The work is being performed in cooperation with the U.S. Geological Survey Water Resources Division, which also has substantial research money. Other State agencies that are on the State review and research Task Force are the Departments of Health, Environmental Conservation, Public Service, the State Energy Office and the Attorney General's Office.

This study is being done in Parts I, II and III; Part I, which has been completed, is divided into two phases. Phase I established a program of monitoring nuclide migration is surface water, groundwater, gaseous and biological pathways. Phase II refined the conceptual model of the pathways, using preliminary field results and determined the feasibility of numerically modeling nuclide migration through these pathways. Results of Part I of the study indicate 1) that ^{14}C and ^{3}H is escaping from the burial trenches in the gaseous phase, and 2) that the origin of trench water build-up is most probably rainwater infiltration from the surface. Erosion rates, slope instability and geomorphic processes have been identified as important considerations in site selection.

Part II, also completed, concluded the understanding of surface water pathways. Trench water chemistry was further analyzed in order to better define the source term. A continued study of gas transport of ^{14}C

and ^{3}H was undertaken. Processes modifying the land surface, such as erosion, mass movement and slope movement, were examined and show that these are the least understood at this phase of the study.

Another phase of the study, supported by the U.S. Nuclear Regulatory Commission, scheduled to be undertaken in 1979, will develop conclusions for long-range management based on the findings of Part I and Part II. The geomorphological processes that modify the land surface will be studied and quantified.

A new study is anticipated, that could be funded by the U.S. Nuclear Regulatory Commission to characterize the geology and groundwater hydrology of the area around the high-level liquid-waste storage tanks.

3.6.3 Deep Well Injection of Liquid Wastes

This is an ongoing evaluation of the geology and hydrology of six different areas where various companies proposed to dispose of waste brine by injecting it into deep subsurface rock formations. Waste brine is generated by salt mining companies and a petroleum company for several reasons, one being the emptying of caverns in underground salt beds for temporary storage of natural gas. The mineralogy and texture of these rocks are studied in conjunction with temperature and neutron logs and pump tests to assess permeability. This work is being done in cooperation with a hydrologist at the U.S. Geological Survey.

3.6.4 Project LURIE - Land Use Resource Information Evaluation

Through a $107,000 grant from the National Science Foundation this project evaluated the impact of natural resource information on land-use decision making. Following interviews with data producers, users, and translators of the information, a cost-benefit study has been designed to evaluate the electronic land-use and natural resource (LUNR) data-processing

system in New York State. The LURIE investigation identified the characteristics of successful communications and recommends improvements in natural resource data products.

3.6.5 Assessment of the Asbestos Air Pollution Hazard Proposed by Quarrying and Road Building in New York State

The Environmental Defense Fund included New York in its list of states whose crushed stone operations should be checked for asbestos to determine if any are air pollution sources. This followed an event in Maryland where chrysotile in serpentine was believed to cause a health problem. A search of the data available at the State Geological Survey, New York State Department of Transportation, and Department of Environmental Conservation concluded that no serpentine rock is being quarried in New YOrk. A program, funded by the U.S. Environmental Protection Agency and coordinated by the Geological Survey, to assess the risk from amphibole asbestos is underway. A search of Adirondack and southeastern New York quarries will be made to determine whether amphibole asbestos is present in any of them.

3.6.6 Information Dissemination

As the beginning of a program to serve the public with quick and easily retrievable data and analyses, the entire list of Geological Survey open file data, maps and reports have been put into computer-compatible form; these have generated lists that are indexed by subject, author, quadrangle, or region-country. These computer lists are presently available through the open-file system and will be published in 1979. With this system it will be possible to obtain quickly a list of all unpublished data for any area, data within a quadrangle, reports by a single author, and data on subjects, such as Devonian stratigraphy or Adirondack Precambrian geology.

3.7 History of Geology and Paleontology

Two articles, one on James Hall and one on Amos Eaton, have been published as this long-term project continues. Another article, tracing in abbreviated form, the development of geology and paleontology in New York since the American Revolution was published in 1978 in conjunction with the 50th anniversary of the New York State Geological Association.

4.0 ANTHROPOLOGICAL SURVEY

The Anthropological Survey is responsible for the study of Native American cultures of New York State in terms of their origins, prehistory, early history, and relationships to large natural and cultural environments. Activities of the Survey include the location and recording of archeological sites through surveys, the systematic excavation of selected sites, and the interpretation of the data and artifacts collected from both prehistoric and historic sites. One objective is to reconstruct, where possible, the economic, technological, social, and religious aspects of the cultures represented on the sites (Figure 3). These cultures are placed in a historical framework by means of various techniques, including radiocarbon dating and their environmental settings, are analyzed with the aid of specialists in Pleistocene geology, riverine sediments, fossil pollen, paleontology, and other disciplines.

Research has established a sequence of Native American occupancy in the State going back to the late glacial period, about 12,000 years ago. Continuing research is gradually filling a few gaps in this sequence. Aboriginal man experienced many environmental changes, some rather dramatic, over this period. In some periods, these variations strongly influenced the evolution of his culture.

Archeological sites are being destroyed by modern civilization. Recent Federal and State legislation has been designed to insure the location, identification, study and protection of sites threatened by publicly funded or licensed construction projects. These regulations, the agencies which are responsible for their implementation, and guidelines used by those agencies have contributed to the rise of "public archeology."

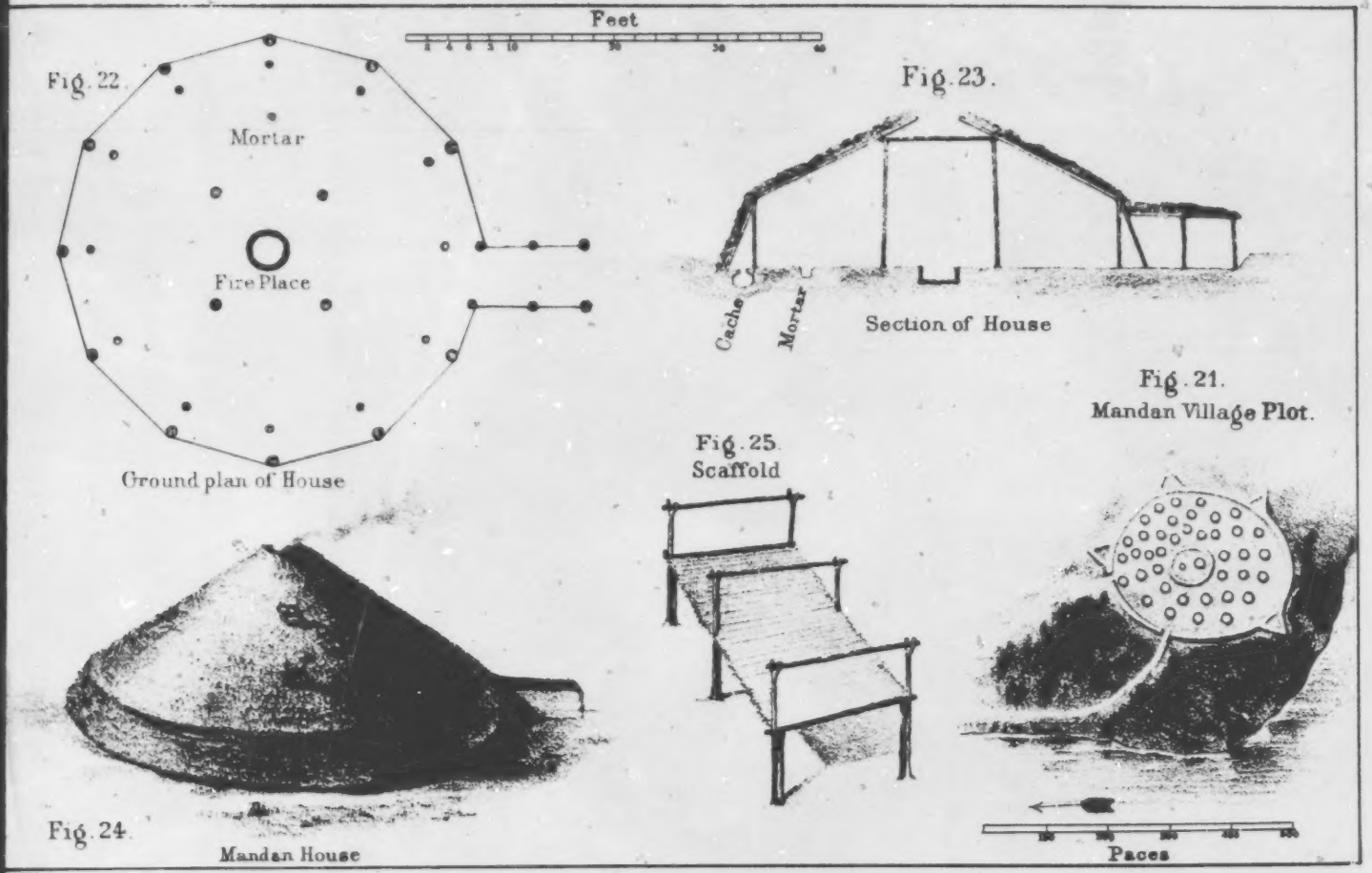


Figure 3. Illustrations of Indian houses and villages. From 21st Annual Report of the Regents of the State of New York on the Condition of the State Cabinet of Natural History, and the Historical and Antiquarian Collections Annexed Thereto. 1867.

This term reflects efforts by archeologists, politicians, and officials to effectively manage our remaining cultural resources. In New York State, the Anthropological Survey plays an important role in this area.

4.1 Prehistoric Archeology

Extensive studies are being done along major waterways including the Hudson, Mohawk, Schoharie and Susquehanna Valleys.

In August 1977, seven seasons of field investigations were completed in the Upper Susquehanna Valley of east-central New York, including major excavations on 17 sites located on the river floodplain. The 1978 summer season was devoted to lab processing of acquired materials and tying up "loose ends" at the final field location. Survey personnel have been assisted by field schools from the State University of New York at Albany and Oneonta throughout these investigations. These schools were directed by Bruce E. Rippeteau and William A. Starna. This project was designed to delineate the sequence of native cultures in the Valley and to describe their patterns of settlement in relation to resources available in the environment.

The investigated sites contained buried living floors pertaining to a number of different prehistoric cultures. Over 100 radiocarbon dates have been obtained for a regional sequence spanning 9,000 years. The Palynologist in the Biological Survey and the Fluvial Geomorphologist in the Geological Survey are providing expertise in their respective fields in this cooperative study. Several bogs in the Upper Susquehanna Valley have been sampled for their long postglacial vegetation sequences and studies of the fossil pollen samples by the Palynologist are nearly complete. These bog sediments have been radiocarbon-dated. Alluvial structures and

and their history are under study by the Fluvial Geomorphologist and James Kirkland of the University of Texas. The botanical and geological data provide a picture of environmental change which will serve as a background for the study of change in early Indian cultures.

Field studies are now complete. The laboratory phase should be finished by late 1979. These results will be incorporated in a book-length report.

The Junior Scientist, Archeology, assisted by nine Community Service students from the State University of New York at Albany, has participated in all aspects of the program.

4.2 Archeological Highway Salvage Program

The Anthropological Survey is responsible for the salvage program which is mandated by law for all Federal aid highway projects in New York State and regulated by the Federal Highway Administration. Preparation of impact statements has been delegated to the New York State Department of Transportation, which requests the scientific data on archeological/structural resources from the Education Department through a cooperative agreement in effect since 1963.

In this largely federally funded program, the Anthropological Survey reviews all proposed Department of Transportation projects for potential impact on cultural resources. Known sites within a project area are identified, the probability that as yet undiscovered sites will occur in other areas of the project is assessed, and, where data on hand is insufficient to make an accurate determination of archeological impact, field studies are recommended and conducted to confirm site locations and evaluate sites for their scientific significance.

Over 70 proposed projects were reviewed for potential impact on archeological resources during 1977 and over 40 projects were reviewed in 1978. Intensive field studies were completed on 62 highway projects in 1977, 38 projects in 1978. These involved a total of over 418 miles of right-of-way. The studies included the survey of proposed highway routes for unrecorded sites and, where present, excavations to determine their size, cultural affiliation and scientific value.

During the 1977 field season, approximately 100 trained undergraduate and graduate archeology students worked part-time under contract to the Education Department either directly or via the Research Foundation of the State University of New York. Approximately 15 temporary Museum staff and 50 trained university students were employed during the eight-month long 1978 field season. Cooperating institutions included the State University of New York at Albany, the State University of New York at Buffalo, the State University of New York at Potsdam, the State University of New York at Binghamton, the State University of New York at Stony Brook, The City College of New York, and Herkimer Community College.

Construction on a project adjacent to recently restored Revolutionary War Fort Stanwix in Rome was monitored. In addition, emergency salvage operations were completed on three prehistoric sites unearthed near Canadarago Lake during construction of a new bridge and approaches in an area not previously surveyed for sites. Salvage excavation of ten prehistoric sites in the Upper Susquehanna Valley along the route of I-88 was completed, the sites having been discovered during the 1975 field survey. Extensive emergency test excavations were carried out in Ogdensburg to determine whether outbuildings associated with the 18th-century French

Fort La Presentation would be affected by proposed highway construction. Emergency research into the probability of impact on archeological deposits in Ogdensburg adjacent to the First U.S. Customs House, and in Albany in connection with excavations along the Hudson River waterfront, was completed in 1978.

Funding of over $500,000 was available in 1977 and $350,000 in 1978 for these field operations. About 80 percent is reimbursable from Federal funds via the Federal Highway Administration and the New York State Department of Transportation.

The project survey reports prepared for the Department of Transportation provide the scientific data necessary for evaluation of the impact of proposed projects on sites, to permit the construction of design alternates to avoid sites of value, and to allow for adequate mitigation of impact, through site preservation or excavation, where required. The data produced by these studies enhances our knowledge of prehistoric and early historic occupation in New York State. It provides valuable information on site locations for statewide archeological site files, thus permitting a more accurate assessment of future impact situations, particularly when coupled with the "negative" data produced where surveys were completed without the discovery of any important resources. Full scale archeological research reports will result from each of the 11 cases of salvage excavation and resultant laboratory analysis, providing additional data not previously available.

4.3 Public Archeology

Six months were spent in revising and updating the statewide archeological site files. Previously, much of the data existed only in the form of field notes, scattered records, or unpublished manuscripts

located in regional museums, universities or in the possession of private citizens. About 3,000 sites were added to the previously existing file of 1,700 sites.

The Anthropological Survey now has a complete topographic map file covering the whole State on which all known and recorded sites and areas surveyed for sites are recorded. These records are also cross-referenced on card files keying the researcher into additional data files and sources of cultural information.

4.4 Curatorial Activities

Work proceeded on cataloguing two private collections which were acquired in prior years. There were five accessions during 1977, including an important collection of 50 Indian baskets donated by Philip and Areden Launer of Scotia, New York, and materials excavated from the Russ and Street sites in the Upper Susquehanna Valley by the State Archeologist. Four loans were made, including seven wampum belts loaned to the Seneca Nation to enhance the opening exhibit in the Museum of the Seneca Nation.

4.5 Cooperative Services

Scientists of the Anthropological Survey received 530 visits from the public and from students and colleagues seeking information. There were also about 2,400 requests each year for assistance by telephone calls or correspondence. During 1978, 12 applications for permits to excavate archeological sites on State lands were reviewed and 10 granted, primarily for underwater investigations on shipwrecks in coastal and inland waters.

An average of 3,000 project notifications for possible environmental impact were reviewed each year by the Public Archeology Coordinator and the Curator, and replies forwarded to the Department of Parks and Recreation where appropriate.

Cooperation with other State agencies included five requests from the Bureau of Criminal Investigation (State Police) for analysis of human bones by the Curator; discussions with the Division for Historic Preservation (Parks and Recreation) concerning the responsibility for maintaining accurate and comprehensive records of archeological sites in the State, and the criteria for evaluating significance of sites threatened by construction projects; responses to requests for information from the Department of Environmental Conservation and the Public Service Commission, and coordination of the highway salvage program involving the Department of Transportation, the Research Foundation of the State University, the State University branches at Binghamton, Buffalo, Albany, and Potsdam, The City College of New York, and Herkimer Community College.

During 1977 and 1978, the State Archeologist advised and assisted two graduate students in their doctoral research. The State University of New York at Albany Community Service students who worked in the laboratory received instruction in northeastern archeology and laboratory techniques from the Junior Scientist and Curator in return for their help.

The State Archeologist continued to serve as Regional Editor for the Journal, Man in the Northeast.

5.0 COLLECTIONS MANAGEMENT

The Collections Management Section was formed on March 1, 1978. Modern collections management utilizes innovative storage methods, up-to-date, sophisticated conservation practices, and automated data retrieval systems. These enhance research potential, specimen accessibility and longevity, and permit construction of natural history and anthropological resource inventories. Museums have become a focal point of activity as awareness increases that they are repositories of irreplaceable natural and cultural heritage information.

5.1 Collections Organization and Storage

Collections Management must insure the safe and efficient transfer of Science Service collections from the State Education Building to the Cultural Education Center, at the opposite end of the Empire State Plaza. The move is scheduled for late 1979. It involves preparation of more than one million specimens collected over the last 40 years. Initial efforts have brought sharply into focus the immediate need for comprehensive long-range collections planning. The impending move created a potential for significant specimen and data loss due to incomplete cataloguing, lack of conservation measures, inadequate storage facilities, and large backlogs of unaccessioned specimens, the results of years of insufficient funding. This potential destruction, if unchecked, would have had significant impact upon the value of the collections as both scientific and educational resources.

The Museum's collections traditionally have been divided into six sections: Paleontology, Geology, Anthropology, Botany, Entomology, and Zoology. Each section had been treated as a separate entity and cared for

by a curator trained in that specific discipline, but not completely aware of methods and practices in the other collections. Thus, interdisciplinary collection interfacing and internal consistency in methodology have been largely lacking. An intensive effort has been made to combine the correction of these deficiencies with those activities specifically designed to reorganize and prepare the collections for safe transferral.

The physical upgrading of the collections includes the correlation of specimens with their catalogue data, completion of specimen inventory, numbering of specimens, and placement of all objects into new storage facilities. These curatorial processes, particularly cataloguing, inventory preparation, and data correlation, had never been completed or were extremely out of date. Cataloguing involves the assignment of museum numbers to specimens and the physical placement of that number on each specimen. A tremendous volume of uncatalogued material had accumulated in some of the collections; the backlog is in the process of slowly being reduced. A specimen inventory and complete correlation of specimens and their data are ancillary procedures which accompany the cataloguing whenever possible. A more extensive and complete inventory will be undertaken as the catalogues are automated.

When upgrading was initiated early in 1978, less than 25 percent of the collections were housed in adequate cabinets. Many specimens were stored in built-in, open wooden drawers along hallways, in closets, behind and even under display cases, or wherever a bit of space had been found. These facilities were not dustproof, insectproof, or fireproof, and in most instances could not be moved without disassembly. Rebuilding these would have been more expensive than purchasing new cabinets. Special appropriations were necessary to acquire the large number of new cabinets

needed for the collections, and the full complement of cases has not yet been provided. However, anticipated funding will allow for completing the acquisition of the required number.

All required cabinets are being purchased prior to the actual collections transfer. This permits the packing of specimens directly in their new cases in preparation for the transfer of each full case as a single unit. This technique allows movers to use mechanical moving equipment, minimizing the handling (and potential breaking) of individual specimens. The new specimen storage units center around "Attica" specimen cabinets, a 32" X 29" X 37" steel case capable of holding 14 steel specimen drawers. These dustproof, pestproof and fireproof cabinets offer an easily accessible and full interchangeable system which readily allows the integration of new specimens without excessive reorganization. The majority of specimens fit into these drawers. However, there are exceptions which must be stored either in special cabinets, i.e., herbarium, zoology, or entomology cases, or on steel shelving.

The packing of the specimens for the transfer posed a number of unusual, logistical problems. The paleontology, geology and archeology collections are, for the most part, packed with layers of cotton mattress "felt." The layers of cotton are pressed firmly on top of the specimens within each drawer; the overlying drawer bottom serves to wedge this packing firmly in place. Oversize specimens are being placed on wooden skids or in specially constructed high-sided, wooden pallets. The zoology, ethnology, and physical anthropology collections are not so simply handled. The specimens come in an extraordinarily wide range of shapes, sizes, and state of fragility. It has been necessary to construct custom crates

for the articulated and fossil skeletons, special pallets for the mounted and oversize specimens, and to create individual packing techniques using foam, plastic sheeting, and bubble plastic for those fragile specimens packed in cases. Specimens stored in glass containers are being packed in boxes and in steel drums cushioned with foam chips.

Among the more challenging tasks associated with the move have been preparations of the many large mounted skeletons once on display (Fig. 4). Both the Blue Whale and the Right Whale skeletons had to be lowered from their long-time home -- suspended from the ceiling of Zoology Hall some 20 feet above the floor. This required the coordinated teamwork of six people working under the direction of a museum consultant experienced in skeleton articulation. The largest of the skeletons, the Blue Whale, is 63 feet in length. Unfortunately, problems did not end with the successful lowering and disassembly. The skull of the Blue Whale is 15 feet long, 5 feet wide, 4 feet high and weighs approximately 1,400 pounds. The greatest dimension of the largest elevator in the Education Building is only 14 feet. It appears as if the only solution is to remove window frames and lower the skull by crane directly down to the street! Other large skeletons also had to be disassembled including the Cohoes Mastodon, the Temple Hill Mastodon and the Irish Elk. All required the skills of a specialist to safely disarticulate these specimens with individual components which weigh as much as 600 pounds. These skeletons have all been packed in specially designed crates and pallets cushioned with thick layers of mattress felt and bubble plastic to assure their safe transfer.

The 5th floor of the Education Building, which served as the museum exhibition area for 70 years, has become the staging area for assembling and packing the collections for the move. Paleontology Hall has been

—Skull of the ELEPHAS GANESA.

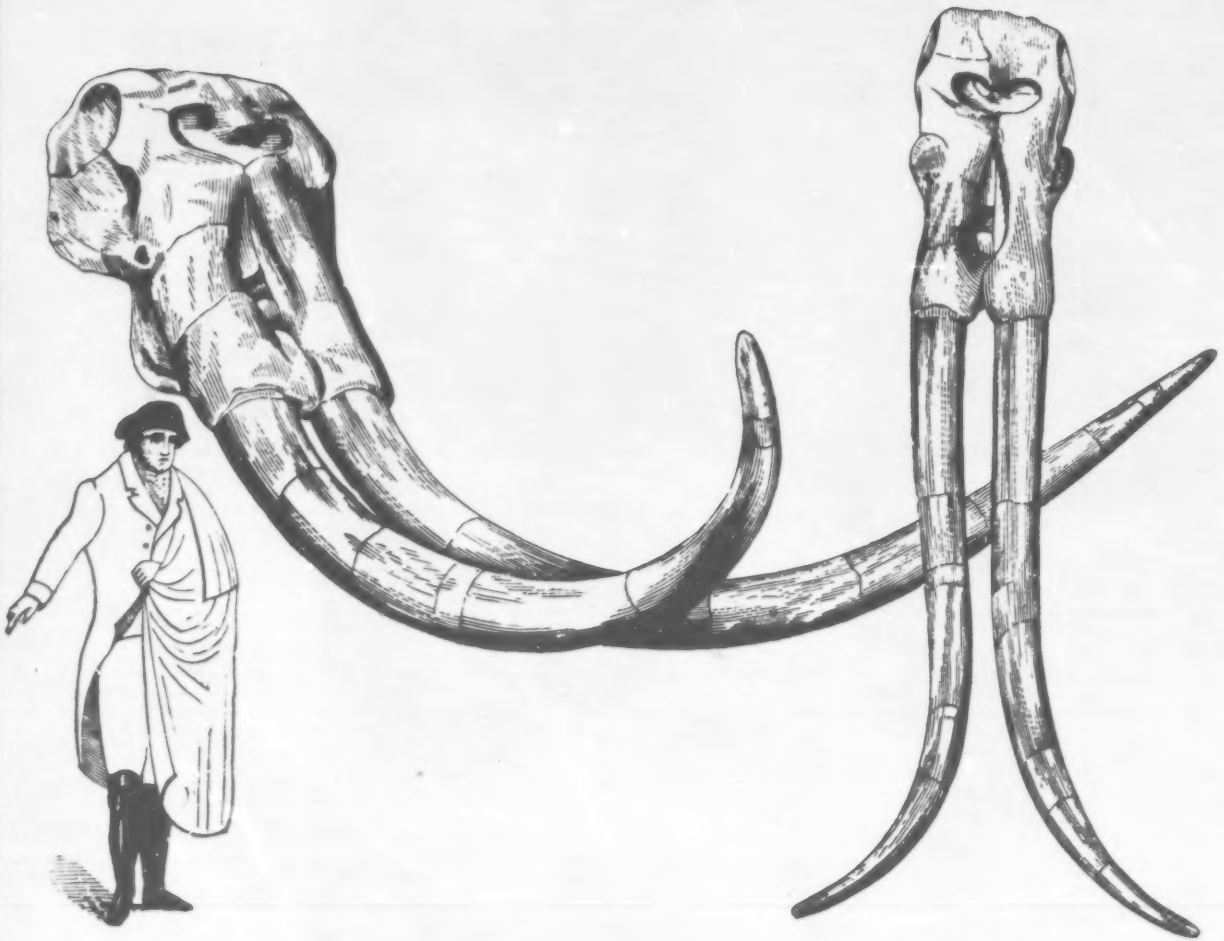


Figure 4. Illustrations of mammoth skulls. From 18th Annual Report of the Regents of the State of New York on the Condition of the State Cabinet of Natural History, and the Historical and Antiquarian Collections Annexed Thereto. 1865.

completely filled with the fossil collection storage cabinets and oversized specimens. Geology Hall now holds all of the cabinets with geology specimens, skids of well cores, pallets of oversize mineral and fossil specimens, and the crated Blue Whale skeleton, Cohoes and Temple Hill mastodons, the Irish Elk, oversize specimens of fish and marine animals from Zoology Hall. The entire archeological collection has been assembled in Zoology Hall and is now being organized, catalogued, and packed. The zoology collections are also gradually being brought up to Zoology Hall and packed in new metal cases. Approximately two-thirds of the total volume of the collections has been relocated on the 5th floor. The remaining third must be integrated with these before the actual transfer can begin.

5.2 Automation of the Data Retrieval and Data Bank Systems

Another fundamental aspect of Collections Management is the development of electronic data processing techniques and the installation of automated data retrieval systems. These are designed to supersede the present manual card files, specimen labels, and notebooks. Automation is based upon SELGEM, an electronic storage and retrieval system developed at the United States National Museum specifically for management of data related to museum collections. SELGEM will permit generation of up-to-date, camera-ready catalogues for photo offset printing and publication, card catalogues, cross index files, subset specimen lists, specimen and drawer labels, and records of activity within the collections. The initial system will be specific to the Science Service collections and its primary applicability will be in the day-to-day research demands made upon the collections. The combination of the automated data retrieval system with the newly upgraded physical storage conditions will markedly facilitate use of the collections.

At present, the paleontology collection is the only one for which data have been totally automated. This project was funded primarily by a three and one-half year, $160,000 National Science Foundation grant which was completed 31 December 1978. The computer-generated card files, labels and catalogues have been installed and already have demonstrated marked superiority over their manual precursors. In the zoology collections, ichthyology and ornithology data are now being transferred into the automated system concurrent with the physical upgrading of the specimens.

The extensive anthropological, entomological and botanical collections are currently the subject of detailed analysis and planning preparations for automation of all related data. The total automation of data for these collections, which represent approximately 1.2 million specimens, is a long-range goal.

5.3 Fumigation

Control of organic destruction in the natural history and anthropological collections is another major concern of Collections Management. At present, some of the museum's collections are sustaining damage from a variety of museum pests, primarily insects. The specimens most susceptible to rapid damage include the many animal and birds skins, the variety of organic materials in the ethnology range, all the dried entomological specimens, and the numerous plants, fungi and lichens in the herbarium.

In the past, a wide variety of chemical pesticides have been used to protect museum collections. Unfortunately, legislation which is meant to protect our environment creates serious problems with preserving

museum collections. Current Environmental Protection Agency (EPA) regulations allow only one fumigant to be used in museum cases. This is DOWFUME 75, a mixture of 30 percent tetrachloride and 70 percent ethylene dichloride. Both chemicals are highly toxic and are also suspected carcinogens. In the near future, because of the nature of these chemicals, DOWFUME 75 will come under more stringent EPA controls and will no longer be available for museum use. This would leave all museums in the untenable position of not having a single approved chemical pesticide with which to protect collections. Adding a specific use to a pesticide label, such as "Application with Museum Cases," is a very expensive process. This is because of the extensive testing required to demonstrate a chemical's effectiveness and safety and the conditions under which it must be used in order to assure safety to applicators and workers.

Collections Management has submitted a $24,959 grant proposal to the National Museum Act of the Smithsonian Institution to explore Federal and state legislation applying to fumigant use in museums, assess available methods of fumigation, and design and implement new methods of pest control. The legal and practical resolution of fumigation problems will be a major step towards the long-term protection of the Museum's collections and collections of museums across the country.

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